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RESEARCH ARTICLE

The Psychological Immune Competence Inventory: A Pilot Validation Study in Slovakia

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Introduction: Psychological immunity refers to an individual's potential to cope with psychological risk factors, as well as to promote and maintain mental health and well-being. The method of its measurement is the Psychological Immune Competence Inventory (PICI), which appears to have good psychometric parameters. Despite the use of translated versions in various foreign studies, the authors have found no studies verifying its factor structure or reliability.
Aims: In this article, our objective is to present the results of the PICI pilot validation in Slovakia. The Slovak version of PICI was expected to have psychometric properties comparable to those of the original version.
Methods: We collected data from a research sample of 213 healthcare students (162 women and 51 men) aged 19 to 35 years (M = 21.18; SD = 2.81), and validated the internal structure of the inventory using Structural Equation Modeling (SEM) via employing the DWLS estimation method. The convergent validity of individual factors was further verified by correlation with personality traits, psychopathological symptoms, preferred coping strategies and trait emotional intelligence.
Results: The results of the second-order confirmatory analysis indicate an acceptable fit of the original model to our data. The convergent validity of the observed individual psychological immunity factors was also supported.
Conclusions: The Slovak version of PICI showed promising psychometric properties. The research serves as a reference to Slovak standardization. Nevertheless, further validation is recommended in a representative sample.

Keywords: psychological immunity, Psychological Immune Competence Inventory, PICI, validation, SEM, Slovak version

Introduction

The past five decades have seen an increased interest in developing new mental health paradigms that extend the biomedical model of disease. The increasing emphasis on prevention, as well as the early identification and promotion of protective factors, has accelerated attempts to introduce specific concepts of health psychology, such as resilience (Block & Block, 1980), coping (Carver, 1997; Lazarus & Folkman, 1984), self-efficacy (Bandura, 1977), a sense of coherence, or salutogenesis (Antonovsky, 1979). There are also clear efforts to develop more comprehensive and applicable models in the field of mental health. Hungarian psychologist A. Oláh (2021) introduced a theoretical model of the psychological immune system to integrate the individual's various adaptive and protective competences into a coherent relational framework.

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Although the concept of psychological immunity has not been conceptualized consistently (Bhardwaj & Agrawal, 2015; Biela et al., 2015; Gilbert et al., 1998), most authors agree that it can be regarded as a psychological equivalent to the biological immune system protecting individuals against psychological risks (Kaur & Som, 2020; Rosenzweig, 2016). Oláh (2021) conceptualized psychological immunity as a set of competences that serve to increase frustration tolerance, foster effective stress reduction, and promote mental health. It includes protective and supportive variables (Kaur & Som, 2020). The protective component largely operates automatically at the unconscious level. The second, proactive component, is conscious and intervenes deliberately to promote the healing process. Both components are influenced by cognitive variables. This differs from the early conceptualization of psychological immunity as being unconscious processes of transforming, ignoring, and rearranging reality, aimed at reducing and neutralizing the consequences of adverse events (Gilbert et al., 1998). Accordingly, former conceptualizations do not work with the idea of proactively and intentionally enhancing the capacity to cope. Attaran et al. (2019) suggest that psychological immunity is a dynamic social-psychological construct that interpersonal relationships form. According to the authors (ibidem), individuals are active agents in shaping and developing their own defenses. They define three key procedures: threat recognition, response generation, and self-regulation.

Bhardwaj and Agrawal (2015) proposed a different model of psychological immunity. Their five-factor model consists of self-confidence, adaptability, emotional maturity, mental well-being, and positive memories of the past. Biela et al. (2015) established a four-component psycho-immunological structure consisting of: strength and will of meaningful life (a joy for life and the ability to see meaning in life); a sense of competence in coping (coping approach to challenges of life); a social support and proactivity (inclusion in a supportive social environment in which one can participate effectively and assertively); and autonomous goals (significant values and interests).

Compared to these conceptualizations of psychological immunity, Oláh (2021) presents a more comprehensive model. It includes analogies to established constructs such as hardiness (Kobasa et al., 1982), self-actualization (Rogers, 1959), self-efficacy (Bandura, 1977), sense of coherence (Antonovsky, 1979), ego-resiliency (Block & Block, 1980), learned optimism (Seligman, 1991), or internal locus of control (Rotter, 1966) and organizes these within a meaningful theoretical framework. The concept of psychological immunity resembles the concept of resilience, albeit more complex. Unlike resilience, which has no consensus on the work definition (Herrman et al., 2011), psychological immunity is clearly defined by specific personality resources. Additionally, the psychological immune system (Oláh, 2021) refines the transactional model of Lazarus (1966) and Lazarus and Folkman (1984) by specifying the cognitive, motivational, and behavioral dimensions that are responsible for the primary and secondary appraisal of potential stressors and coping abilities.

Oláh (2021) has also developed a psychological immunity assessment instrument known as the Psychological Immune Competence Inventory (PICI). The PICI inventory has a high application potential to identify vulnerable individuals and capture impaired competences to cope with stress as well as protective variables using personalized profiles.

Factor structure of the Psychological Immune Competence Inventory

The 80-item Psychological Immune Competence Inventory (Oláh, 2021) contains 16 factors merged into three subsystems:

A) Approach-Belief subsystem (ABS);
B) Monitoring-Creating-Executing subsystem (MCES);
C) Self-regulating subsystem (SRS).

The approach-belief subsystem is responsible for the primary appraisal process to assess situations as potentially stressful. It controls the attitude of individuals toward self and the environment and directs the tendency to approach or avoid the demands of life and self-actualization. Therefore, the subsystem contains: positive thinking (personality dimensions that facilitate positive anticipations in situations beyond personal control); sense of control (attitude toward perceived control over life circumstances); sense of coherence (belief of meaningfulness, comprehensibility and manageableness of life) and sense of self-growth (individual's stable belief in their own ability to continually improve).

The monitoring-creating-executing subsystem, responsible for the secondary appraisal process of evaluating coping options when facing potential stressors, includes variables related to the exploration of challenges and new experiences, variables needed to actualize the internal and social resources, and executive variables that are related

to the creation of alternative solutions. These are: creative self concept (individual's strong belief in their own creative potential, self-worth, and the value of their achievements); self-efficacy (expectation of being able to achieve the desired results); goal orientation (ability to maintain motivation and endurance in completing tasks, despite obstacles); problem-solving capacity (ability to reconstruct learned experiences to create alternative solutions); change and challenge orientation (openness to new experiences, and the perception of change as an opportunity); social monitoring capacity (sensitive and selective observation, along with the use of social or environmental information to achieve future goals), social mobilizing capacity (ability to manage human resources to achieve future goals) and social creation capacity (personal influence on creating social groups, based on inspirational ideas).

The third, the self-regulating subsystem, ensures the stability of the whole system by regulating intrapsychic tension that would interfere with the desired goals and contains the following variables: synchronicity (the ability to be in congruence with the current external environment or task, while maintaining concentration); impulse control (ability to manage an individual's own behavior by means of rational control over spontaneous and impulsive action); emotional control (ability to regulate negative emotions that are induced by the anticipation of failure) and irritability control (ability to constructively regulate the impatience and anger resulting from unmet needs).

The psychometric properties of the inventory's original Hungarian version have been validated in a series of studies (Oláh, 2021) and demonstrate solid results. The Cronbach's alphas and test-retest correlations in the sample of 1612 respondents (735 women and 877 men) exhibited high reliabilities. The reliability of the subscales ranged from α = .62 to .80 (M = .73), indicating good internal consistency. The high test-retest stability after two weeks was confirmed by correlations ranging from .77 to .89 (M = .84). In cross-sectional studies, the convergent and discriminant validity of the 16 factors was confirmed by correlations with personality traits, ego-resiliency, coping style, emotional intelligence, burnout syndrome, and psychopathological symptoms (Oláh, 2021). The exploratory factor analysis evaluated the internal structure of the inventory in a sample of 1,679 respondents (850 women and 829 men), which was subsequently validated by confirmatory factor analysis in a sample of 1,073 respondents (452 men and 621 women).

Rationale and Objectives

Previous research has shown that psychological immunity predicts the level of performance satisfaction (Bóna, 2014) and is positively associated with life satisfaction (Voitkāne, 2004). The relationship between coping and psychological immunity in healthcare professionals has also been proven (Dubey & Shahi, 2011). The authors (ibidem) found that active coping was positively correlated with all three subsystems. Bodys-Cupak et al. (2016) found that people with a high sense of self-efficacy prefer active coping, planning, and positive reframing in stressful situations. Furthermore, active coping is classified as part of the problem-focused coping style (Carver, 1997; Litman, 2006) and is orientated toward active problem-solving. The monitoring-creating-executing and self-regulating subsystems are also positively linked to flow experience (Albert-Lőrincz et al., 2011). Psychological immunity has been shown to be a protective factor against burnout syndrome (Gombor, 2009). Within the context of psychopathology, previous research on psychological immunity has shown a negative relationship between depression and the three subsystems of psychological immunity (Voitkāne, 2004). One of the commonest comorbidities is that of depression and anxiety (Ballenger, 2000) both of which are associated with repetitive negative thinking (Luca, 2019) and negative appraisals of the individual's ability to cope with challenging situations (Tahmassian & Moghadam, 2011).

Although translated versions of the PICI have been used in foreign countries (Dubey & Shahi, 2011; Voitkāne, 2004), there is a lack of evidence regarding their psychometric parameters or an adaptation process. Despite the inventory's perceived utility, it was studied primarily in Hungary (Oláh, 2021). To our knowledge, to date no one has studied the concept of psychological immunity within the social and cultural context of the Slovak Republic. This study seeks to explore the factor structure of the Slovak version of PICI and verify its psychometric characteristics in a pilot study. In our research, we expected the Slovak version of PICI to have the appropriate psychometric properties.

In the context of convergent validity, we hypothesized that psychological immunity and its three subsystems would correlate positively with the resilient personality type that is characterized as an optimal constellation of personality traits in terms of coping (Asendorpf & Denissen, 2006; Oshio et al., 2018). We anticipated positive relationships with openness to experience, extraversion, agreeableness and conscientiousness, and negative relationship with neuroticism. We also hypothesized a negative correlation between overall psychological immunity and its subsystems as well as the actual psychopathological burden.

At the level of individual psychological immunity factors, we expected associations with selected coping strategies and with factors of emotional intelligence. More specifically, for coping strategies, we proposed a positive relationship between active coping and the selected psychological immunity factors: goal orientation, self-efficacy, and problem-solving capacity. Due to the similarity between the operational definitions of both constructs, we expected a positive correlation between active coping and the problem-solving capacity of the psychological immune system. Similarly, due to semantic proximity, we also expected a positive relationship between the positive reframing coping strategy and the psychological immunity factor of positive thinking defined as the facilitation of positive expectations. Within the context of emotional intelligence, it was expected that the self-control factor of the trait emotional intelligence would be positively correlated with emotional control and irritability control within the self-regulating subsystem. Furthermore, it was expected that the sociability factor of emotional intelligence, which represents effective communication and interpersonal skills, would be positively associated to those factors of psychological immunity related to soft social skills: social monitoring capacity, social mobilizing capacity, and social creation capacity. The well-being factor of the trait emotional intelligence represents perceived personal well-being, meaningfulness in life, and self-esteem; hence, it is conceptually close to the factors of positive thinking, creative self concept, and sense of coherence of psychological immunity. Consequently, a positive correlation was expected between well-being and the factors of psychological immunity listed above. At the same time, we expected associations with selected symptoms of psychopathology. Since depression and anxiety are related to an overwhelming burden, it can be expected that both are negatively linked to personal abilities to overcome psychological adversity or to protect oneself against stress, such as positive thinking, sense of coherence, sense of self-growth, creative self-concept, synchronicity and emotional control.

Methods

Participants and Data Collection

The final research sample consisted of 213 participants aged 19 to 35 years (M = 21.18; SD = 2.81). Of these, 76.1% were women (n = 162) and 23.9% were men (n = 51). Participants were healthcare students from the Slovak Medical University in the first and third years of their university studies. We conducted the survey in November 2021. The test battery was administered in paper-and-pencil format in groups during a lecture. Participants fully completed all surveys and there were no missing data. The study was carried out according to the ethical principles of psychological research and the Declaration of Helsinki (World Medical Association, 2013). Participants signed an informed consent form and participated voluntarily without compensation. Data are stored in coded databases without personal data, and the authors have policies in place to keep data secure. The research was reviewed and approved by the Slovak Medical University.

Measures

The Psychological Immune Competence Inventory

The Psychological Immune Competence Inventory (Oláh, 2021) consists of 80 items that load 16 factors, which are merged into three subsystems. Each item is answered by a four-point Likert-type scale. The Slovak version of the inventory was translated from the English version of PICI (Oláh, 2021) using a standard back-translation technique (Cha et al., 2007), with the author's approval. Three researchers provided the translation independently. After discussion, a consensus was reached on the final version. Another professional psychologist, an English expert, provided the back-translation. The back-translated version was compared to the original English instrument with a high degree of concept equivalence. In this study, Cronbach's alphas for the particular scales are as follows: Global level of Psychological Immunity (α = .94); Approach-Belief subsystem (α = .84); Monitoring-Creating-Executing subsystem (α = .89); Self-regulating subsystem (α =.85); Positive Thinking (α = .80), Sense of Control (α = .55), Sense of Coherence (α = .74), Sense of Self-Growth (α = .66), Creative Self Concept (α = .72), Self-Efficacy (α = .70), Goal Orientation (α = .77), Problem-Solving Capacity (α = .77), Change and Challenge Orientation (α = .79), Social Monitoring Capacity (α = .75), Social Mobilizing Capacity (α = .77), Social Creation Capacity (α = .77), Synchronicity (α = .70), Impulse Control (α = .65), Emotional Control (α = .78) and Irritability Control (α = .73).

The NEO-FFI

The NEO-FFI (Costa & McCrae, 1992) is based on the five-factor personality model. The answers are given on a five-point Likert-type scale. The Slovak version of the inventory was standardized by Ruisel and Halama (2007) and is available from the publisher. In this study, Cronbach's alphas for the particular scales are as follows: Neuroticism (α = .85), Extraversion (α = .84), Openness to experience (α = .71), Agreeableness (α = .72), and Conscientiousness (α = .85).

The SCL-90®-S

The SCL-90®-S (Franke, 2014) is a 90-item inventory designed to assess the current psychological burden through subjectively perceived physical and psychological symptoms of nine factors (Hostility, Anxiety, Depression, Paranoid Ideation, Phobic Anxiety, Psychoticism, Somatisation, Interpersonal Sensitivity, and Obsessive-Compulsive Symptoms), measuring three global indexes. Items are answered on a five-point Likert-type scale according to the severity of the symptom. The version used in recent research was standardized by Pulkrabková (2020) and is available from the publisher. In the present study, the reliability of the subscales used is as follows: Depression (α = .91), Anxiety (α = .89), and the Global Severity Index (α = .98).

The Brief-COPE Inventory

The Brief-COPE Inventory (Carver, 1997; Hegarty & Buchanan, 2021) is used to identify three coping styles and 14 coping strategies. The short version of the inventory has 28 items that are answered on a four-point Likert-type scale. The inventory was translated by the first two authors from the original English version and back-translated by the third author to achieve concept equivalence. In the present study, the estimates of Cronbach's alphas are as follows: A) Problem-focused coping (α = .78): Active coping (α = .72), Use of instrumental support (α = .78), Positive reframing (α = .65), Planning (α = .68); B) Emotion-focused coping (α = .56): Use of emotional support (α = .73), Venting (α = .31), Humour (α = .91), Acceptance (α = .44), Religion (α = .87), Self-blame (α = .57); and C) Avoidant coping (α = .67): Self-distraction (α = .74), Denial (α = .53), Substance use (α = .86), and Behavioural disengagement (α = .68).

The TEIQue-SF

The TEIQue-SF (Petrides, 2009), standardized in the Slovak language by Kaliská et al. (2015), is a questionnaire designed to measure the total score of trait emotional intelligence and four sub-factors. The questionnaire consists of 30 items that are answered on a seven-point Likert-type scale. In the present study, the reliability of the subscales used is as follows: Emotional intelligence (α = .89), Well-being (α = .85), Self-control (α = .71), Emotionality (α = .66) and Sociability (α = .57).

Statistical Analysis

Data were processed using the JASP statistical program, version 0.17.2 (JASP Team, 2023). In the first step, we checked the internal consistency of the Slovak version of the Psychological Immune Competence Inventory (PICI) using Cronbach's alpha. To verify the factorial validity of the inventory, we performed a second-order confirmatory factor analysis using structural equation modeling (SEM). Finally, to test the convergent validity, the PICI subscales were correlated with the Big Five personality traits, perceived psychopathological symptoms, preferred coping strategies and facets of trait emotional intelligence.

The data obtained from the responses to the four-point Likert-type scale of the validated instrument were treated as ordinal variables. This decision would appear to be the most suitable because data measured by a Likert-type scale can be considered as interval variables if the scale is longer (Asún et al., 2016), respectively, it has more than five categories (Harpe, 2015) and ideally 11 (Wu & Leung, 2017).

Parameter estimates were based on a polychoric correlation matrix, using the diagonally weighted least squares method (DWLS) with robust corrections to standard errors. This method of model estimation appears to be more suitable than the maximum likelihood method (ML) for ordinal variables, assuming a normal distribution of the latent variables rather than the observed variables (Li, 2016). Furthermore, in the confirmatory factor analysis of models with ordinal variables, the DWLS method is characterized by more accurate

chi-square test values, lower standard errors in parameter estimates, and a better performance of the different fit indices (DiStefano et al., 2019). This method was also chosen because neither the exact tests nor the skewness and kurtosis values (Z scores within ±1.96) confirmed the normal distribution of the data (Hair et al., 2006). Finally, the use of this method is suitable for the validation of models with a larger number of items or latent variables and with a smaller research sample (DiStefano et al., 2019; Flora & Curran, 2004), as well as for shorter ordinal scales (Soukup, 2021). In the model estimation, we employed the available case analysis (pairwise deletion), as recommended by Asparouh and Muthén (2010). To evaluate the fit of the model to the research data, the chi-square test (χ^2), the chi-square and degrees of freedom ratio (χ^2/df), and five model fit indices were used: root mean square error of approximation (RMSEA); standardized root mean squared residual (SRMR); comparative fit index (CFI); Tucker-Lewis index (TLI); and parsimonious normed fit index (PNFI).

The chi-square and degrees of freedom ratio (χ^2/df) indicates an acceptable fit of the model to the research data if its value is less than three. The root mean square error of approximation value (RMSEA) as well as the standardized root mean squared error residual value (SRMR) are expected to be less than .08 for a fair model fit and less than .05 for an excellent model fit (Mindrila, 2010). Hu and Bentler (1999) defined the cut-off scores of the comparative fit index (CFI) and the Tucker-Lewis Index (TLI) for a good model fit as those greater than .95, and those greater than .9 for an acceptable fit. However, these are the cut-off scores for the maximum likelihood method (ML), which is suitable for interval variables. Although these CFI and TLI cut-off values are often used in studies applying the DWLS method, an ongoing debate continues on the evaluation of model fit based on these values when using DWLS. It is recommended to use CFI and TLI values above .99 (Xia & Yang, 2019), or rather to rely on the value of the SRMR index, which is independent of the estimation method (Shi & Maydeu-Olivares, 2020). The optimal suggested value of the parsimonious normed fit index (PNFI) is more than .75 in a research sample of 150 participants and more than .76 in a sample size of 250 participants (Sivo et al., 2006).

In the context of factor loading, Hair et al. (2006) pointed out that the sample size influences its magnitude and, for samples consisting of 200 participants, they set the acceptable factor loading cut-off value at .40. Despite that, they recommend a cut-off point of .50 and ideally .70, irrespective of the sample size. However, items with a factor loading greater than .45 can be considered as acceptable, greater than .55 as good, greater than .63 as very good, and those greater than .71 as excellent (Haugan et al., 2020; Sharma, 1995).

Results

Based on the reliability analysis, satisfactory reliability values were found for the global level of psychological immunity (α = .94), all the subsystems (α ranging from .84 to .89) and for most of the factors. The data do not show sufficient reliability for three factors of the Slovak version of PICI: Sense of Control (α = .55), Sense of Self-Growth (α = .66) and Impulse Control (α = .65). The Cronbach's alphas for the other individual factors range from .70 to .80.

Confirmatory Factor Analysis

The results of the confirmatory factor analysis using SEM show that the original second-order factor structure of the model (Model 1) fits fairly to the data due to the absolute indexes (RMSEA = .072; SRMR = .094; χ^2 = 6409.315; df = 3061; χ^2/df = 2.09), incremental indexes (CFI = .930; TLI = .927), and even the parsimonious normed fit index (PNFI = .847). Standardized factor loadings for the original two-level model with 16 first-order factors and 3 second-order factors (Model 1) are presented in Table 2, and intercorrelations of the factors are reported in Table 3.

In addition to the original model (Model 1), we also analyzed a modified model to improve its fit indices. Therefore, items with a standardized factor loading below 0.45 were removed (Model 2). Specifically, 14 items were deleted with the following sequence: 14, 62, 34, 80, 78, 18, 2, 50, 44, 37, 9, 77, 53, 28. The confirmatory factor analysis shows a slightly better fit of the modified model to our data than the original model, due to the absolute indexes (RMSEA = .068; SRMR = .090; χ^2 = 4089.712; df = 2060; χ^2/df = 1.99), incremental indexes (CFI = .952; TLI = .950), and even the parsimonious normed fit index (PNFI = 0.871). The modified model indicates a sig-

Table 1. Descriptive statistics of factors in the Slovak version of the PICI inventory

	M	*SD*	*SK*	*Std. Err. SK*	*KU*	*Std. Err. KU*	*S-W*	*p*
Positive Thinking	15.13	3.29	-0.52	0.17	-0.51	0.33	0.95	< .001
Sense of Control	14.13	2.53	-0.04	0.17	-0.07	0.33	0.98	.002
Sense of Coherence	15.49	3.08	-0.62	0.17	-0.28	0.33	0.95	< .001
Sense of Self-Growth	13.74	3.04	-0.25	0.17	-0.05	0.33	0.98	.009
Creative Self Concept	15.13	2.95	-0.54	0.17	-0.17	0.33	0.96	< .001
Self-Efficacy	13.94	3.36	-0.22	0.17	-0.46	0.33	0.98	.003
Goal Orientation	14.54	3.15	-0.32	0.17	-0.35	0.33	0.98	< .001
Problem-Solving Capacity	14.55	2.79	-0.28	0.17	-0.46	0.33	0.97	< .001
Change and Challenge Orientation	13.85	2.91	-0.10	0.17	-0.02	0.33	0.98	.008
Social Monitoring Capacity	13.06	2.96	0.21	0.17	-0.29	0.33	0.98	.003
Social Mobilizing Capacity	15.42	3.29	-0.41	0.17	-0.71	0.33	0.95	< .001
Social Creation Capacity	12.79	2.96	0.08	0.17	-0.11	0.33	0.98	.016
Synchronicity	11.43	3.28	0.01	0.17	-0.68	0.33	0.98	< .001
Impulse Control	13.57	3.20	-0.44	0.17	0.01	0.33	0.97	< .001
Emotional Control	12.27	3.57	-0.22	0.17	-0.68	0.33	0.97	< .001
Irritability Control	12.68	3.46	-0.11	0.17	-0.81	0.33	0.98	< .001

Note. M – Mean; *SD* – Standard Deviation; *SK* – Skewness; *Std. Err. SK* – Standard Error of Skewness; *KU* – Kurtosis; *Std. Err. KU* – Standard Error of Kurtosis; *S-W* – Shapiro-Wilk test; *p* – p value of the Shapiro-Wilk test.

nificant difference from the original model ($\Delta\chi^2$ = 2319.603; Δdf = 1001; p < .001). However, after removing the problematic items, an insufficient number of items was left in two factors (one item in the Sense of Control and two items in the factor of Impulse Control). Furthermore, this modification has unfavorably affected the reliability of individual factors. Specifically, the estimates of Cronbach's alphas for these factors are as follows: Sense of Self-Growth (α = .58), Self-Efficacy (.69), Synchronicity (.63), Impulse Control (.48) and Irritability Control (.72). Since in the Sense of Control factor, only one item remained after the modification, it was not possible to calculate its reliability.

Convergent Validity

To examine convergent validity, the correlation between the global psychological immunity level (GPI), including its three subsystems (ABS, MCES, SRS), and the Big Five personality traits (neuroticism, extraversion, openness to experience, agreeableness, conscientiousness), the general psychological burden of subjectively perceived symptoms of psychopathology (GSI), the general level of emotional intelligence (EI) and well-being (WB) were examined. We present the results in Table 4. The hypothesized negative correlation between psychological immunity and neuroticism, along with the positive correlation with the other four personality factors, was partially supported. The results support a moderate to strong negative correlation of neuroticism with global psychological immunity (GPI) and also its subsystems (ranging from -.76 to -.53). A positive relationship with extraversion and conscientiousness was also supported (ranging from .35 to .62). Agreeableness exhibited a weak correlation with psychological immunity (ranging from .15 to .33), and openness to experience did not correlate at all. Psychological immunity showed a significant negative relationship with general psychological burden (ranging from -.36 to -.61), as well as moderate to strong positive relationships with emotional intelligence and well-being (ranging from .46 to .79).

Table 2. Standardized factor loadings for the original two-level model with 3 second-order factors (subsystems) and 16 first-order factors (Model 1)

Subsystem	Factor	Item number (standardised factor loading)				
Approach-Belief subsystem	Positive Thinking (.92)	1 (.63)	17 (.63)	33 (.77)	49 (.78)	65 (.82)
	Sense of Control (.67)	2 (.45)	18 (.39)	34 (.05)	50 (.56)	66 (.76)
	Sense of Coherence (.91)	3 (.65)	19 (.61)	35 (.85)	51 (.45)	67 (.75)
Monitoring-Creating-Executing subsystem	Sense of Self-Growth (.92)	5 (.53)	21 (.76)	37 (.44)	53 (.43)	69 (.64)
	Creative Self Concept (1.06)	4 (.63)	20 (.66)	36 (.67)	52 (.54)	68 (.70)
	Self-Efficacy (.93)	9 (.43)	25 (.56)	41 (.56)	57 (.82)	73 (.65)
	Goal Orientation (.67)	13 (.71)	29 (.62)	45 (.81)	61 (.88)	77 (.43)
	Problem-Solving Capacity (.72)	8 (.53)	24 (.60)	40 (.82)	56 (.70)	72 (.76)
	Change and Challenge Orientation (.70)	6 (.61)	22 (.75)	38 (.75)	54 (.80)	70 (.70)
	Social Monitoring Capacity (.32)	7 (.77)	23 (.60)	39 (.79)	55 (.57)	71 (.54)
	Social Mobilizing Capacity (.58)	10 (.81)	26 (.82)	42 (.65)	58 (.53)	74 (.76)
	Social Creation Capacity (.68)	11 (.76)	27 (.72)	43 (.75)	59 (.48)	75 (.72)
Self-regulating subsystem	Synchronicity (.92)	12 (.54)	28 (.45)	44 (.42)	60 (.88)	76 (.75)
	Impulse Control (.83)	14 (.04)	30 (.60)	46 (.82)	62 (.33)	78 (.41)
	Emotional Control (.896)	15 (.63)	31 (.62)	47 (.75)	63 (.55)	79 (.89)
	Irritability Control (.50)	16 (.53)	32 (.75)	48 (.68)	64 (.80)	80 (.35)

Table 3. Intercorrelations of factors in the Slovak version of the PICI inventory

	GPI	ABS	MCES	SRS	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12	F13	F14	F15	F16
GPI	-																			
ABS	.87**	-																		
MCES	.90**	.71**	-																	
SRS	.78**	.59**	.50**	-																
F1	.78**	.84**	.67**	.54**	-															
F2	.40**	.52**	.39**	.16*	.29**	-														
F3	.70**	.84**	.55**	.49**	.63**	.27**	-													
F4	.66**	.75**	.50**	.53**	.50**	.15*	.59**	-												
F5	.63**	.50**	.70**	.37**	.50**	.27**	.37**	.34**	-											
F6	.29**	.16*	.42**	.07	.18**	.17*	.12	-.00	.15*	-										
F7	.61**	.51**	.53**	.52**	.40**	.26**	.40**	.46**	.27**	-.02	-									
F8	.80**	.73**	.80**	.49**	.67**	.37**	.62**	.51**	.52**	.24**	.41**	-								
F9	.60**	.38**	.71**	.35**	.40**	.20**	.29**	.26**	.45**	.32**	.30**	.57**	-							
F10	.69**	.65**	.72**	.36**	.48**	.44**	.50**	.56**	.41**	.17*	.53**	.60**	.41**	-						
F11	.54**	.43**	.59**	.31**	.41**	.22**	.35**	.29**	.36**	.20**	.21**	.38**	.17*	.33**	-					
F12	.58**	.38**	.73**	.26**	.44**	.20**	.29**	.21**	.44**	.33**	.18**	.52**	.64**	.45**	.36**	-				
F13	.66**	.63**	.44**	.72**	.54**	.19**	.52**	.61**	.30**	.01	.39**	.49**	.20**	.43**	.29**	.20**	-			
F14	.46**	.36**	.25**	.68**	.32**	.23**	.27**	.26**	.10	.06	.33**	.29**	.23**	.21**	.10	.09	.32**	-		
F15	.69**	.52**	.50**	.81**	.50**	.09	.43**	.50**	.40**	.03	.44**	.48**	.41**	.32**	.28**	.31**	.59**	.37**	-	
F16	.45**	.26**	.28**	.69**	.26**	.04	.26**	.17*	.25**	.11	.30**	.19**	.21**	.14*	.17*	.17*	.24**	36**	.41**	-

Note. *GPI* – Global level of psychological immunity; *ABS* – Approach-Belief subsystem, *MCES* – Monitoring-Creating-Executing subsystem; *SRS* – Self-regulating subsystem; *F1* – Positive Thinking ; *F2* – Sense of Control; *F3* – Sense of Coherence ; *F4* – Sense of Self-growth ; *F5* – Change and Challenge Orientation ; *F6* – Social Monitoring Capacity ; *F7* – Goal Orientation ; *F8* – Creative Self Concept; *F9* – Problem-Solving Capacity; *F10* – Self-Efficacy; *F11* – Social Mobilizing Capacity ; *F12* – Social Creation Capacity; *F13* – Synchronicity ; *F14* – Impulse Control; *F15* – Emotional Control; *F16* – Irritability Control.

*. Correlation significant at .05 level (2-tailed).
**. Correlation significant at .01 level (2-tailed).

Table 4. Correlation matrix of examined second-order PICI variables

	N	E	*O*	*A*	*C*	*GSI*	*EI*	*WB*
GPI *CI 95%*	-.73** [-.78, -.66]	.60** [.51, .68]	.13 [-.01, .26]	.25** [.12, 37]	.54** [.44, 63]	-.53** [-.62, -.43]	.79** [.74, .84]	.72** [.65, 78]
ABS *CI 95%*	-.64** [-.71, -.55]	.52** [.41, .61]	.09 [-.04, .23]	.23** [.10, .35]	.56** [.46, .64]	-.48** [-.58, -.37]	.73** [.66, .78]	.73** [.66, .79]
MCES *CI 95%*	-.53** [-.62, -.42]	.62** [.53, .70]	.17 [.09, .30]	.15 [.02, .28]	.51** [.40, .60]	-.36** [-.47, -.24]	.72** [.65, .78]	.67** [.59, .74]
SRS *CI 95%*	-.76** [-.81, -70.]	.36** [.24, .47]	.04 [-.10, .17]	.33** [.20, .44]	.35** [.22, .46]	-.61** [-.69 -.52]	.59** [.49, .67]	.46** [.35, .56]

Note. *GPI* – Global level of psychological immunity; *ABS* – Approach-Belief subsystem, *MCES* – Monitoring-Creating-Executing subsystem; *SRS* – Self-regulating subsystem; *N* – Neuroticism; *E* – Extraversion; *O* – Openness to experience; *A* – Agreeableness, *C* – Conscientiousness, *GSI* - Global severity index referring to the general psychological burden of perceived psychopathological symptoms; *EI* – Emotional intelligence; *WB* – Well-being.

*. Correlation significant at .05 level (2-tailed)
**. Correlation significant at .01 level (2-tailed)

Table 5. Convergent validity of examined first-order PICI factors

PICI factor	Examined converging factor	Spearman's correlation CI 95%
Positive Thinking	Positive reframing (Brief-COPE)	.48** [.37, .58]
	Well-being (TEIQue-SF)	.73** [.67, .79]
	Anxiety (SCL-90®-S)	-.40** [-.50, -.28]
	Depression (SCL-90®-S)	-.56** [-.65, -.46]
Sense of Coherence	Well-being (TEIQue-SF)	.63** [.55, .71]
	Anxiety (SCL-90®-S)	-.33** [-.45, -.21]
	Depression (SCL-90®-S)	-.50** [-.60, -.40]
Sense of Self-Growth	Anxiety (SCL-90®-S)	.36** [-.47, -.23]
	Depression (SCL-90®-S)	-.50** [-.60, -.39]
Creative Self Concept	Well-being (TEIQue-SF)	.53** [.42, .62]
	Anxiety (SCL-90®-S)	-.21* [-.33, - .07]
	Depression (SCL-90®-S)	-.40** [-.51, -.28]
Self-Efficacy	Active coping (Brief-COPE)	.31** [.18, .43]
Goal Orientation	Active coping (Brief-COPE)	.34** [.21, .45]
Problem-Solving Capacity	Active coping (Brief-COPE)	.24** [.10, .36]
Social Monitoring Capacity	Sociability (TEIQue-SF)	.43** [.31, .53]
Social Mobilizing Capacity	Sociability (TEIQue-SF)	.40** [.28, .51]
Social Creation Capacity	Sociability (TEIQue-SF)	.37** [.25, .48]
Synchronicity	Anxiety (SCL-90®-S)	-.49** [-.58, -.38]
	Depression (SCL-90®-S)	-.60** [-.68, -.51]
Emotional Control	Self-control (TEIQue-SF)	.69** [.62, .76]
	Anxiety (SCL-90®-S)	-.56** [-.64, -.46]
	Depression (SCL-90®-S)	-.61** [-.69, -.51]
Irritability Control	Self-control factor (TEIQue-SF)	.43** [.31, .53]

*. Correlation significant at .05 level (2-tailed)
**. Correlation significant at .01 level (2-tailed)

To verify convergent validity at the level of individual psychological immunity factors, we anticipated relationships with selected coping strategies (active coping and positive reframing in Brief-COPE), perceived psychopathological symptoms (depression and anxiety in SCL-90®-S), and factors of emotional intelligence (well-being, self-control, and sociability in TEIQue-SF). Table 5 reports the results. As expected, active coping was positively related to goal orientation, self-efficacy and problem-solving capacity, and positive reframing coping strategy was positively related to positive thinking. The results also supported assumptions about the association of psychological immunity factors with trait emotional intelligence. The anticipated associations were also confirmed in the cases of depression and anxiety.

Discussion

Efforts to identify alternative mental health approaches as opposed to the reductionist biomedical paradigm are attracting increased attention. The comprehensive model of psychological immunity introduced by Oláh (2021) seeks to further this endeavor. It defines psychological immunity in a multidimensional way as a set of personal competences to cope with psychological risk factors, promote mental health and maintain general well-being. The inventory designed to measure psychological immunity appears to be a useful diagnostic tool in the field of healthcare and prevention. Despite its promising potential, it has mainly been studied in Hungary, and psychometric evidence from other countries remains lacking. Hence, our main objective in the present study was to provide evidence regarding the validity of the Slovak version of the Psychological Immune Competence Inventory (Oláh, 2021) in a pilot study.

The values of Cronbach's alpha indicate a high level of reliability for 13 out of a total of 16 factors. The low reliability may be due in part to the fact that, for the purposes of the pilot study presented here, we translated the English version of the inventory. The inventory's psychometric properties may also be affected by the specificity of the research sample. As found in other research (Široká et al., 2023), medical students can perceive an increased psychopathological burden. The mean profile of the psychological immune system can provide useful information on these students' functioning. Our data indicate that healthcare students may have problems in the self-regulating subsystem. However, self-regulating skills are crucial to dealing with patients, using critical thinking, and for meaningful learning. The lowest level was found in the synchronicity factor. This factor is considered as an ability to be mentally present in the moment. Reinforcing the self-regulating competences can contribute to medical students' more adaptive functioning in terms of preventing negative consequences of stress, such as burnout syndrome.

Based on the second-order confirmatory factor analysis, the original model of the psychological immune system proved to be acceptable, although not ideal for our data. Accordingly, we also analyzed a modified model. The removal of problematic items has slightly improved the fit indices. However, this modification has affected the reliability of individual factors unfavorably. Therefore, we suggest using the original model and recommend verifying the psychometric properties of the Slovak version of the PICI inventory on a representative sample.

Within the context of convergent validity, the research conducted to date has supported the negative relationship of psychological immunity with depression (Voitkāne, 2004), psychopathological symptoms (Oláh, 2021) and burnout syndrome (Gombor, 2009) and its selected sections with maladaptive cognitive schemas, experiencing loneliness and negative emotional states (Zábó et al., 2022). On the other hand, psychological immunity has been shown to be positively related to mental and physical health (Oláh, 2021), life satisfaction (Bóna, 2014; Gombor, 2009), life aspirations (Voitkāne, 2004), emotional intelligence (Oláh, 2021), life meaningfulness, and experiencing positive emotions (Zábó et al., 2022).

On a broader perspective, a large amount of scientific evidence has so far supported the partial constructs of the psychological immune system. In the field of identifying protective factors of mental health, research has been well-documented on optimism (Conversano et al., 2010), self-efficacy (Zhou et al., 2021), sense of coherence (Griffiths, 2009) or emotional stability (Aschwanden et al., 2021; Kroencke et al., 2020; Liu et al., 2021). Considerable research interest has also been devoted to the Transactional model of coping with stress (Lazarus, 1966; Lazarus & Folkman, 1984).

In the present study, a statistically significant positive correlation was supported between global psychological immunity (and its three subsystems) and extraversion, conscientiousness, emotional intelligence and well-being. By contrast, a significant negative relationship was indicated with neuroticism and the psychological burden of perceived psychopathological symptoms. These results support the construct validity of psychological immunity.

At the level of psychological immunity factors, we expected convergence with selected coping strategies, perceived burden of psychopathological symptoms and factors of emotional intelligence. In the context of coping strategies, our results support the assumption of a positive relationship between active coping and psychological immunity factors of goal orientation, self-efficacy, and problem-solving capacity. Our results regarding positive relationships between facets of emotional intelligence and factors of the psychological immune system support a view of psychological immunity not only as a defense against psychological risks, but also as a capacity to proactively maintain mental health and well-being. These results are consistent with findings on the association between psychological immunity and mental health (Oláh, 2021), life satisfaction (Voitkāne, 2004) and adaptive functioning (Albert-Lőrincz et al., 2011; Gombor, 2009; Stankovic et al., 2022). The negative correlation of depression and anxiety with selected factors of psychological immunity (positive thinking, sense of coherence, sense of self-growth, creative self-concept, synchronicity and emotional control) points to the applicability of the Slovak version of the PICI in the field of detecting vulnerable individuals with insufficient coping resources.

Strengths and Limitations

The findings of this research should be viewed through the prism of certain limitations, one of which is the composition of the research sample that consists of a specific group of medical students, mostly in early adulthood. The level of psychological immunity is also influenced by developmental factors (Bredács, 2019) and can also vary among students from different disciplines (Bredács & Kárpáti, 2012). Furthermore, the research population was not balanced by gender, biased in favor of women. Possible limitations are due to the translation from the English version of the PICI inventory. In future research, we will perform another translation from the original Hungarian version and refine the Slovak version accordingly.

Further limitations stem from the very nature of cross-sectional studies, which are conducted by self-evaluation methods. Additionally, the verification of psychometric properties would also need to be supplemented by test-retest reliability and also by testing the invariance of the model across different age, educational and ethnic groups, as well as in terms of gender. Given the limitations, we consider the research findings to be beneficial in our particular context, serving as important data for further adapting the Slovak version of the PICI. The study's results also contribute to the topic of the psychological immunity in medical students. The knowledge of strengths and limitations of psychological immunity in healthcare students can be used to plan preventative programmes and interventions to address stress in medical students.

Conclusions, Implications and Future Directions

Psychological immunity is an interdependent system of resource personality factors that protect an individual from the harmful consequences of psychological distress and, at the same time, promote mental health. Our results, regarding the second-order confirmatory analysis, indicate an acceptable fit of the original model to our data. The data also supported the convergent validity of the individual psychological immunity factors observed. However, it would be desirable to verify the results in a representative research sample and through longitudinal follow-up. The psychological immune system model (Oláh, 2021) appears to be a valuable framework for understanding the structure of protective personal competences and possesses significant potential for application. The Psychological Immune Competence Inventory can be used for effective detection and the dispensarization of potentially vulnerable individuals. In addition, personalized profiling can be useful in promoting mental health on the level of individuals, not just by detecting potentially impaired functions, but also by defining resource variables to reinforce specific competences.

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Author contribution
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Declaration of interest statement
The authors declare that they have no conflict of interest.

Ethical statement
This manuscript is the authors' original work.
All participants engaged in the research voluntarily and anonymously.
Their data are stored in coded materials and databases without personal data.
The studies involving human participants were reviewed and approved by the Slovak Medical University on 4 October 2021.

Data Availability Statement
Datasets presented in this article are available from the corresponding author upon reasonable request.

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